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PROBABILISTIC INTEGRATED URBAN INUNDATION MODELING USING SEQUENTIAL DATA ASSIMILATION

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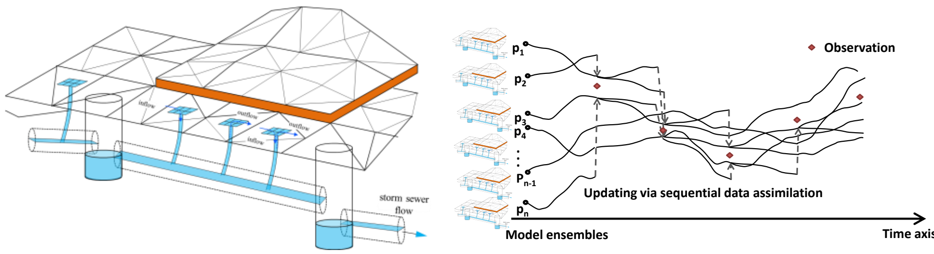
Urban inundation due to climate change and heavy rainfall is one of the most common natural disasters worldwide. However, it is still insufficient to obtain accurate urban inundation predictions due to various uncertainties coming from input forcing data, model parameters, and observations. Despite of numerous sophisticated data assimilation algorithms proposed to increase the certainty of predictions, there have been few attempts to combine data assimilation with integrated inundation models due to expensive computations and computational instability such as breach of conservation and momentum equations in the updating procedure. In this study, we propose a probabilistic integrated urban inundation modeling scheme using sequential data assimilation. The original integrated urban inundation model consists of a 2D inundation model on the ground surface and a 1D network model of sewer pipes, which are combined by a sub-model to exchange storm water between the ground surface and the sewerage system. In our method, uncertainties of modeling conditions are explicitly expressed by ensembles having different rainfall input, initial conditions, and model parameters. Then, particle filtering (PF), one of sequential data assimilation techniques for non-linear and non-Gaussian models, is applied to sequentially update model states and parameters when new observations are arrived from monitoring systems. Several synthetic experiments are implemented to demonstrate applicability of the proposed method in an urbanized area located in Osaka, Japan. The discussion will be focused on noise specification and updating methods in PF and comparison of accuracy between deterministic and probabilistic inundation modeling methods.

MATERIALS AND STUDY AREA

Figure 1(a) shows the concept diagram of the integrated urban inundation model (Lee *et al.* [1]). It consists of a 2D inundation model on the ground surface and a 1D network model of sewer pipes; a sub-model combines those two models and the exchange of storm water between the ground surface and the sewerage system employing the weir and orifice formula (Lee [2]). To disentangle uncertainties in urban inundation modeling, we consider model ensembles and implement sequential data assimilation (e.g. Noh *et al.* [3]), whose conceptual diagram is shown in Fig. 1(b). The study area and modeling mesh of the ground surface are shown in Fig. 2.



(a) Deterministic (b) Probabilistic

Figure 1. Concept of deterministic and probabilistic urban inundation modeling

(a) Study area (b) Mesh

Figure 2. Study area and mesh

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